QUASAR SAT

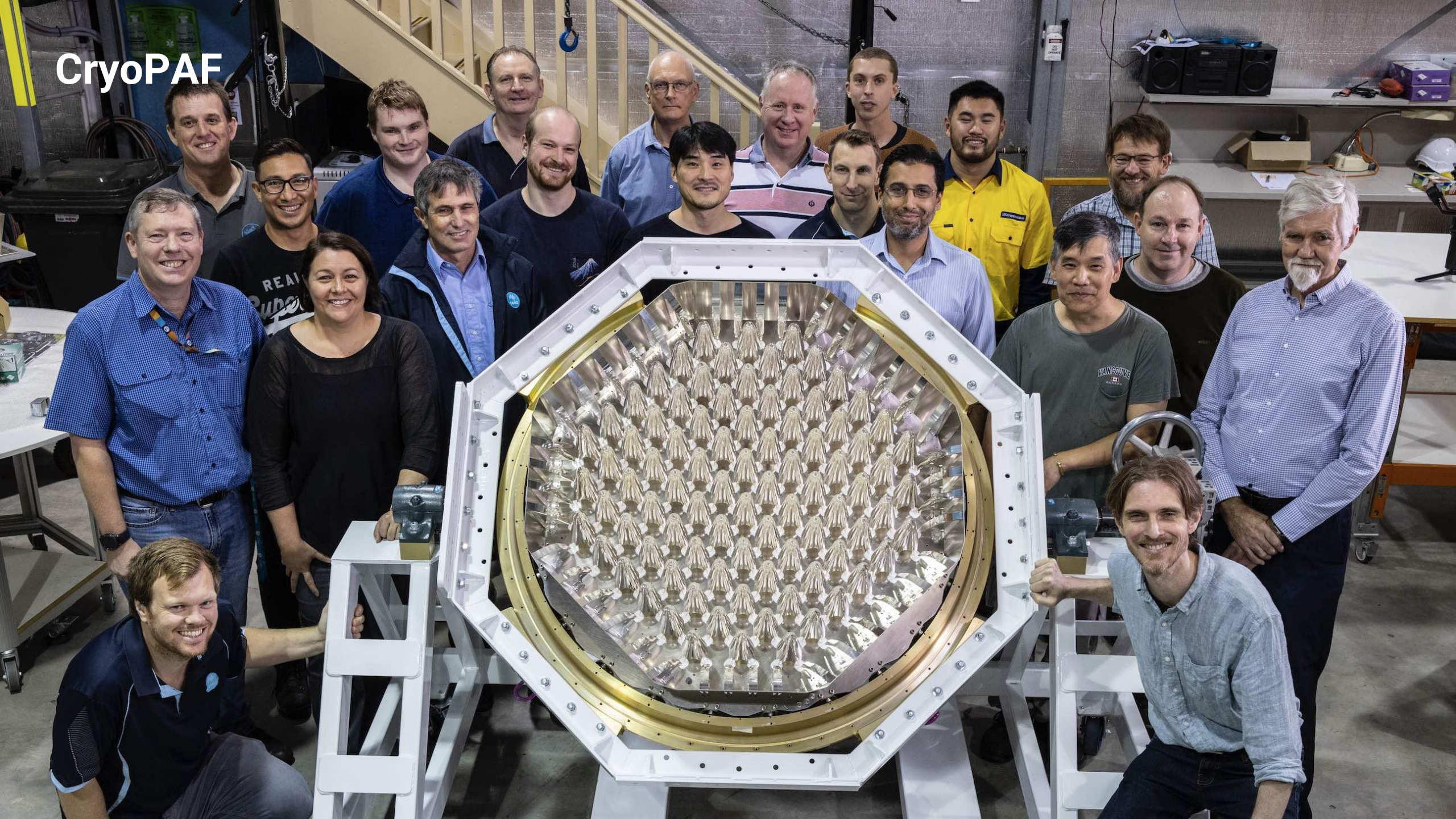
Commercialising cryoPAF Technology

Mike Boers (Quasar) and Mark Bowen (CSIRO)

12 Oct 2022

Origin

CryoPAF



Quasar Satellite Technologies

Quasar Satellite Technologies Pty Ltd is an Australian company developing an advanced satellite Ground Station as a Service (GSaaS) offering.

Quasar is backed by funding, technology and industry expertise from CSIRO, Main Sequence, the Office of the NSW Chief Scientist & Engineer, and Australian companies Vocus, Saber Astronautics, Fleet Space Technologies, and Clearbox Systems.

Quasar are designing and building a high throughput pure digital ground station based on the multibeam phased array technology, developed and enhanced by CSIRO for radioastronomy over the past decade.

Quasar Satellite Technologies

Supported by the

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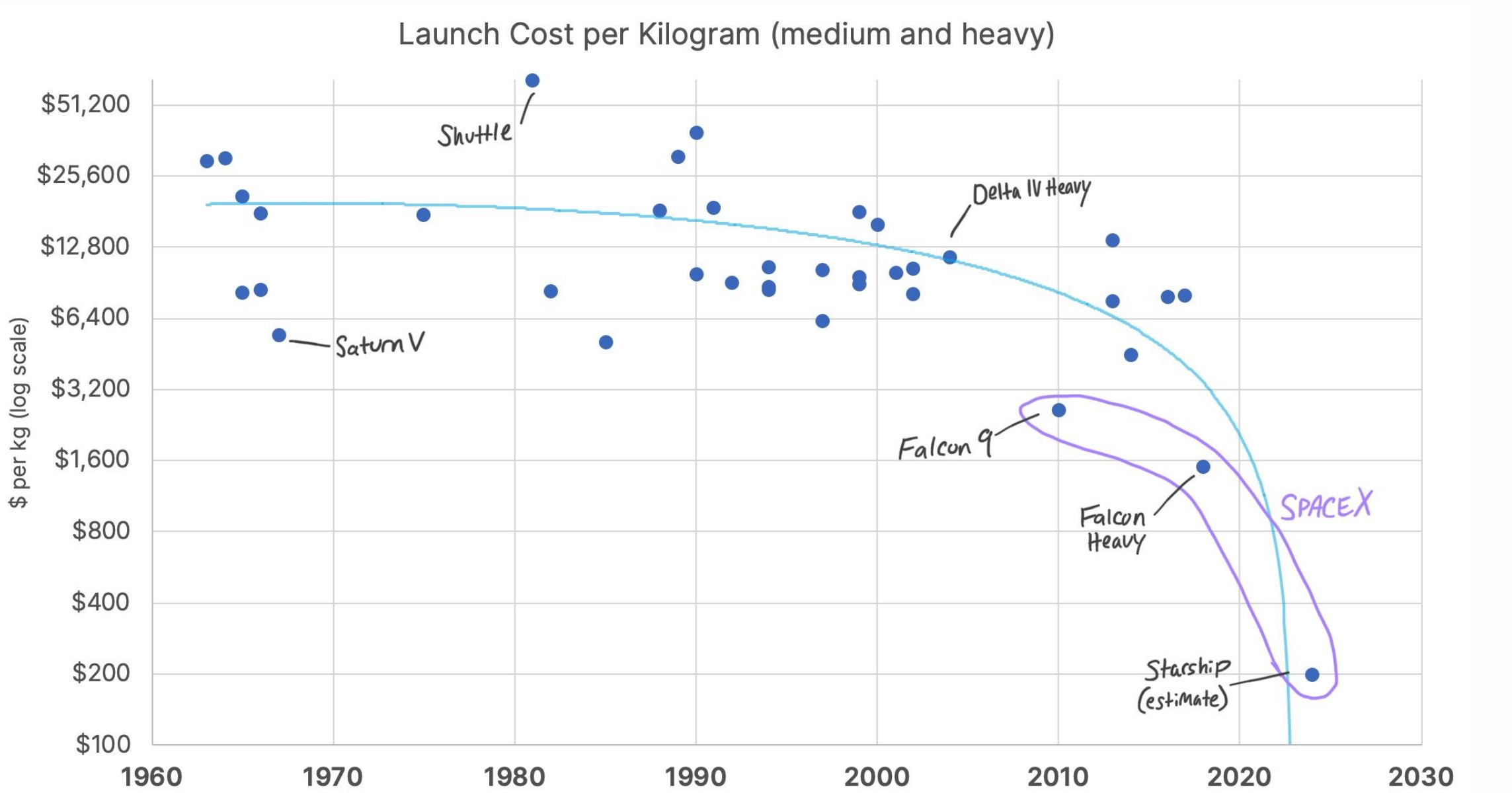
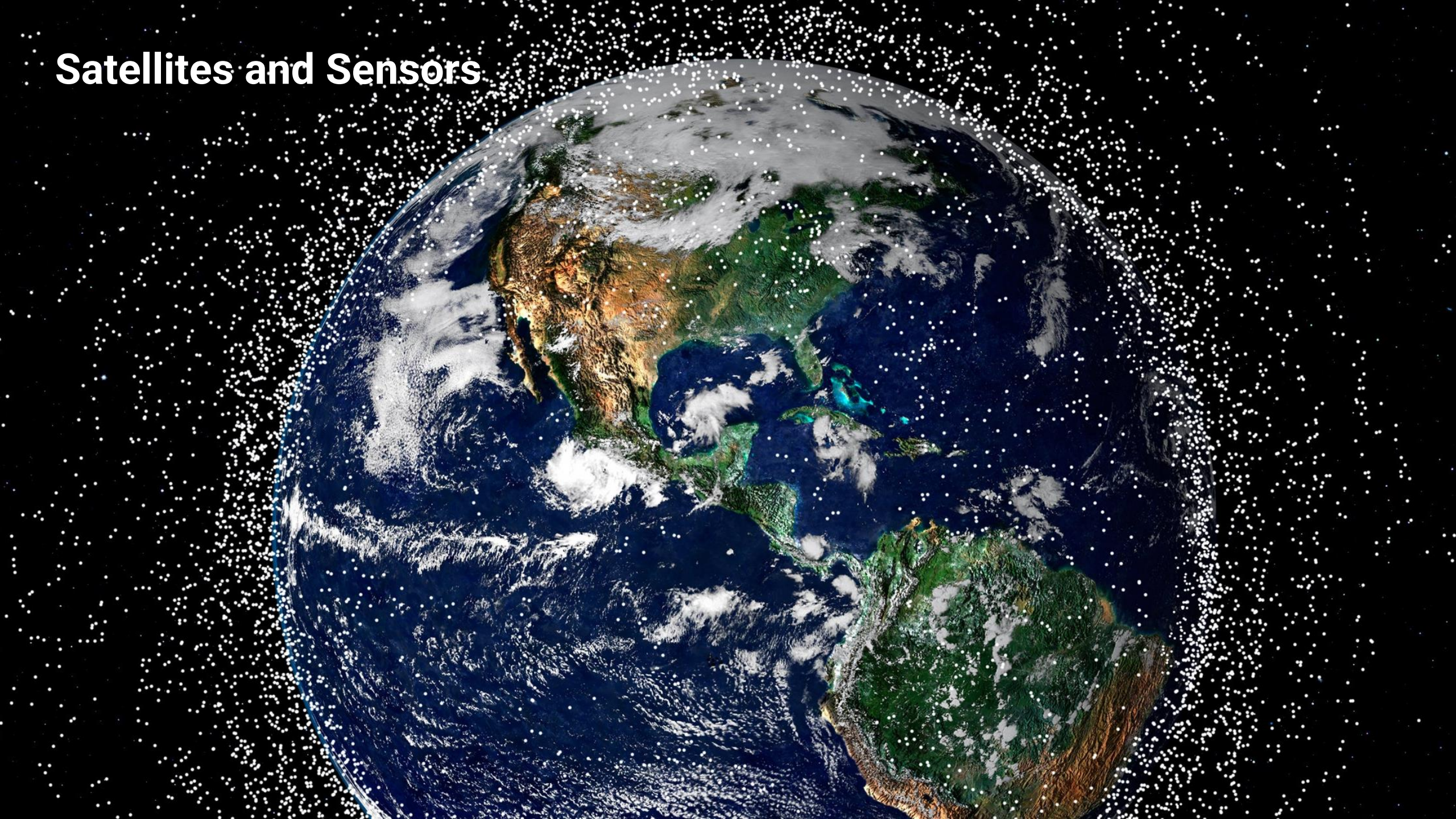
New Space

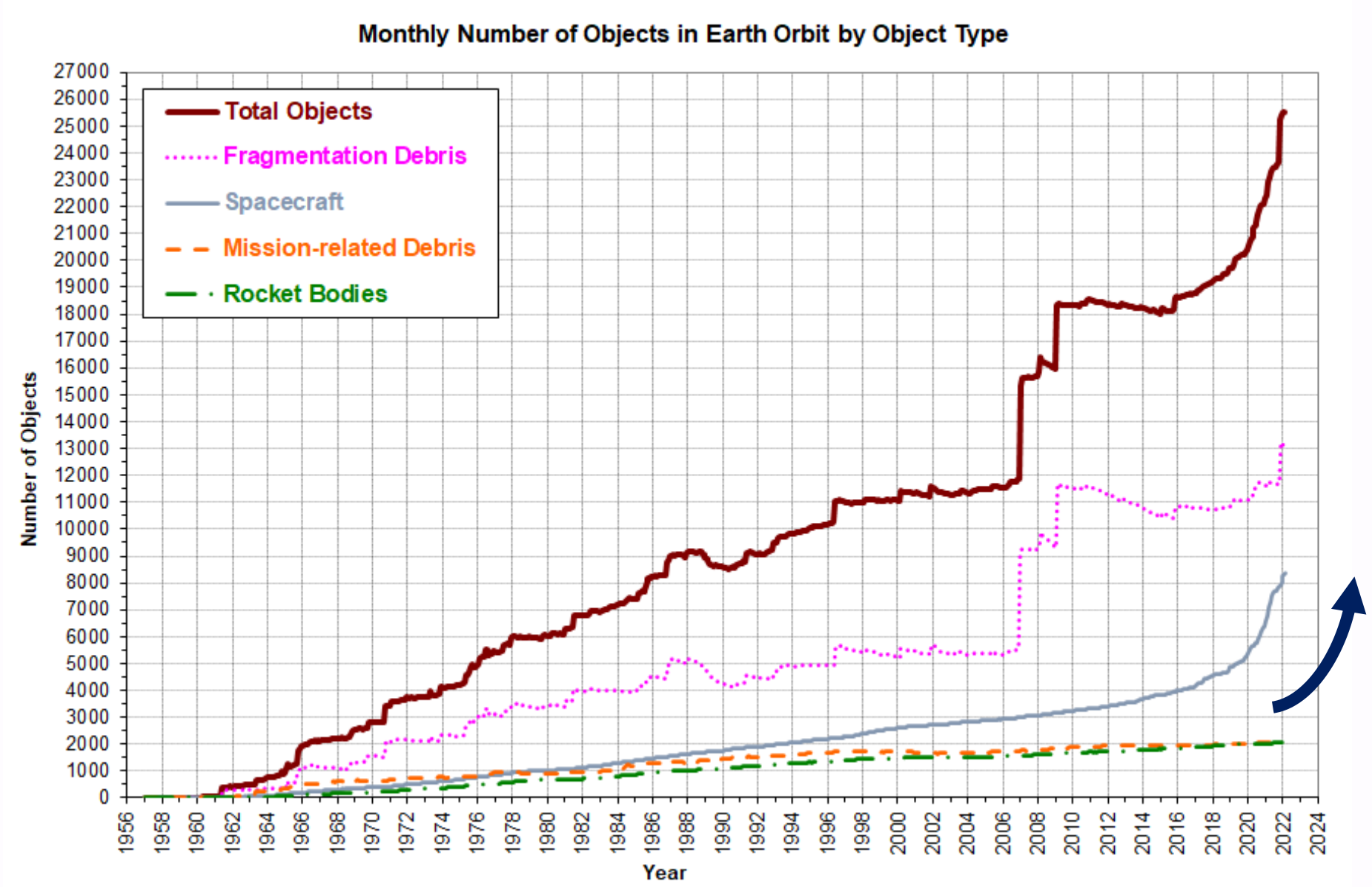
- Three pillars
  - Launch
  - Satellites
  - Ground
- Convergence of 2 factors
  - Low cost Launch
  - COTS electronics



https://ttu-ir.tdl.org/bitstream/handle/2346/74082/ICES_2018_81.pdf
https://futureblind.com/2021/03/03/the-future-of-space-1/

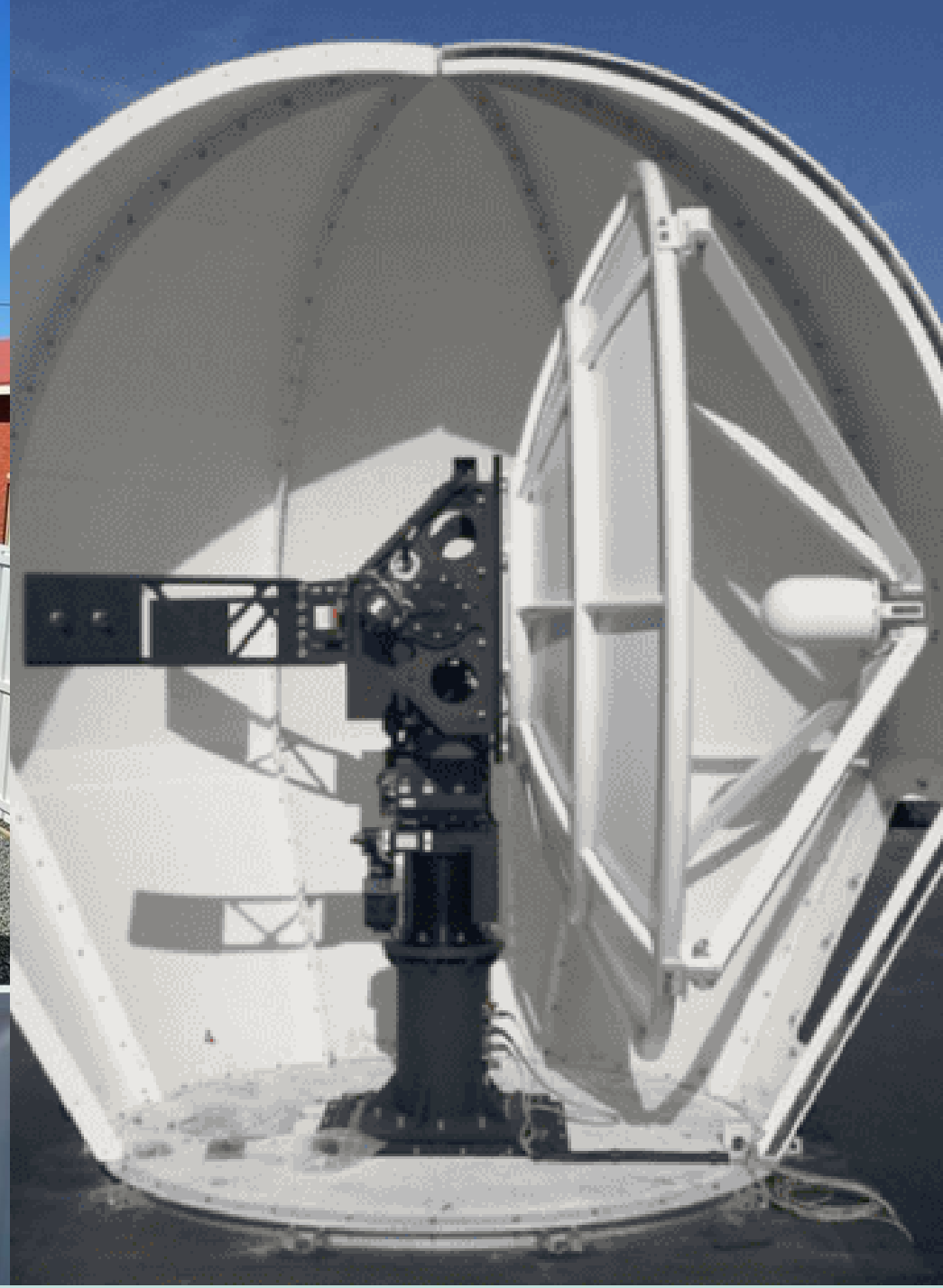
Satellites and Sensors

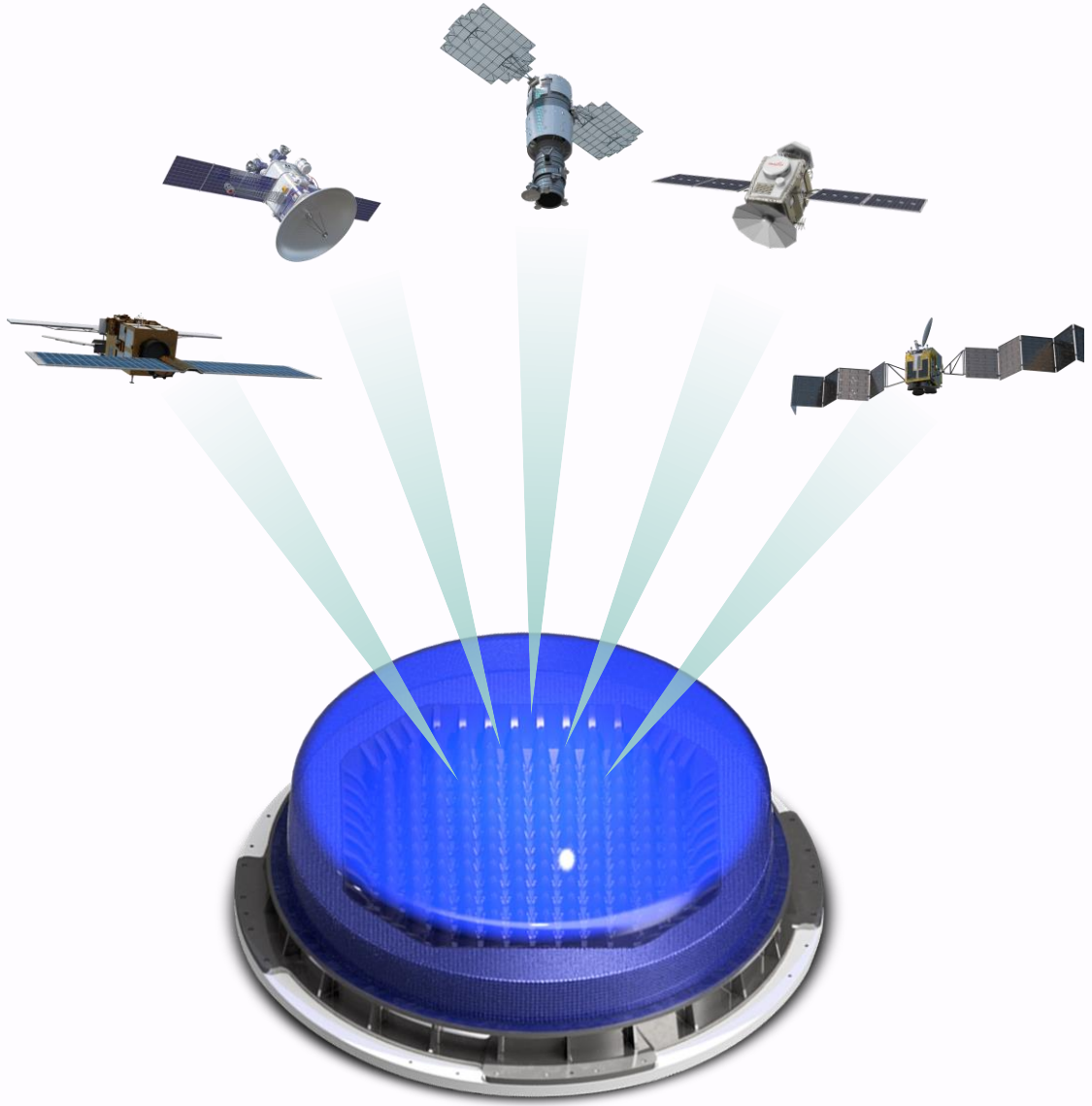




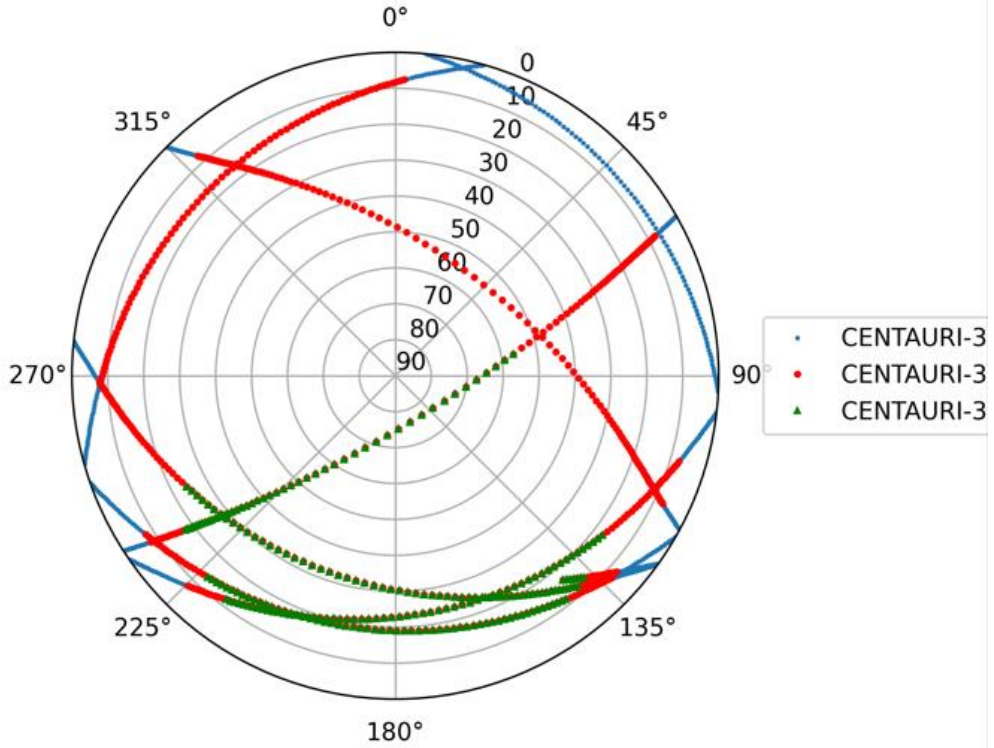
Source: NASA Johnson Space Centre Orbital Debris Program

Ground Stations

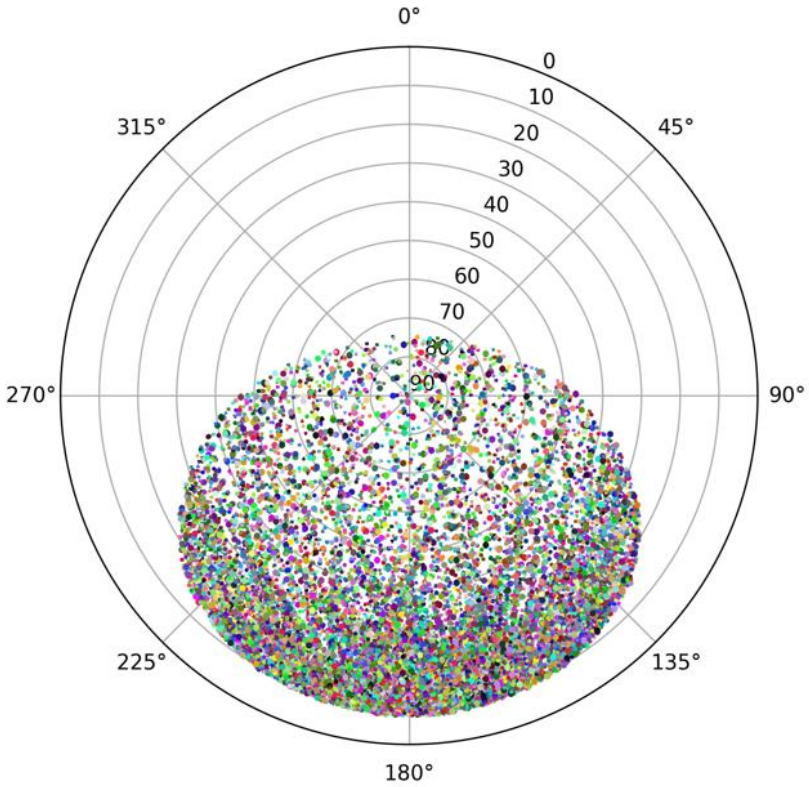




Pass Modelling



CENTAURI-3 (TYVAK-0210) (47966)
22-08-24 00:00:00 UTC - 22-08-24 23:54:40 UTC
Total passes: 8



https://github.com/skyfielders/python-skyfield

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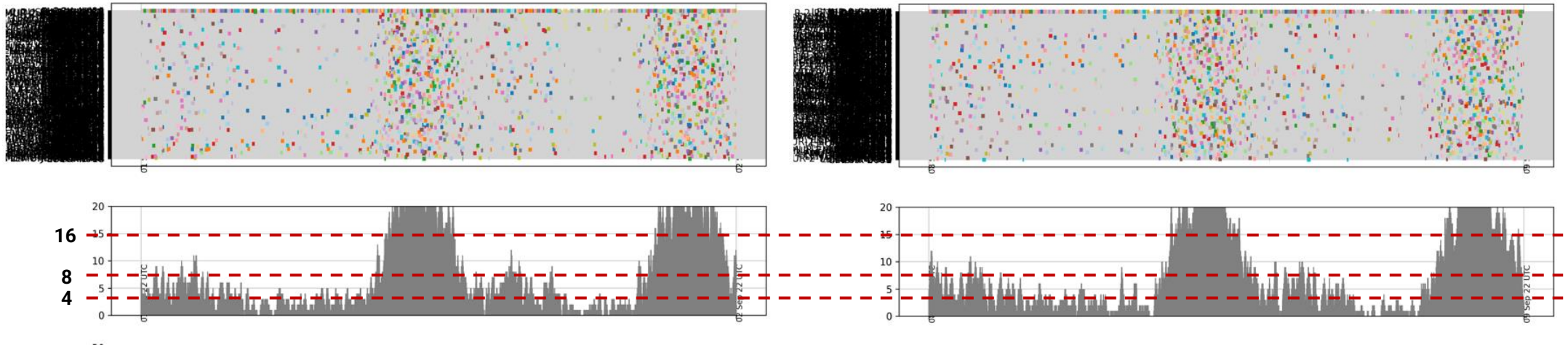
Selected EO satellites

01 Sep 22 UTC - Satellite Access Plot

08 Sep 22 UTC - Satellite Access Plot

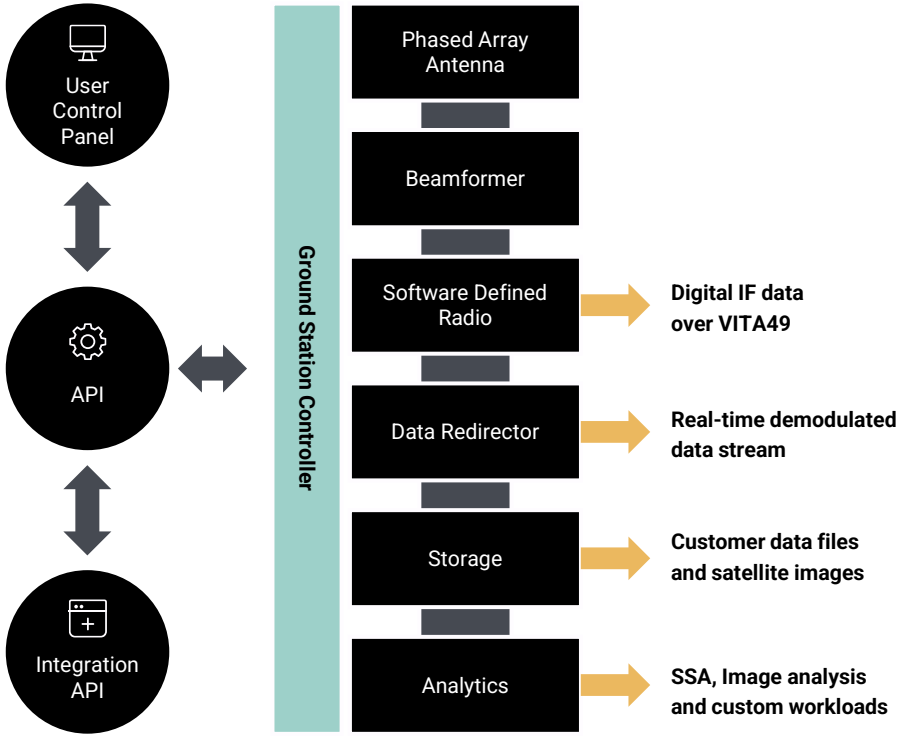
Awarua NZ



Markets

- Communications
- Earth observation
- Universities
- Science

System architecture

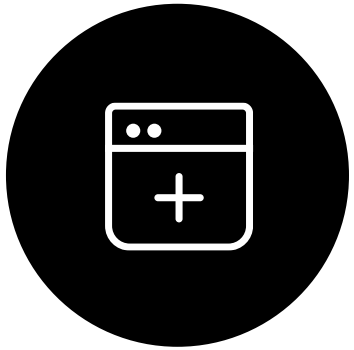


System Stack

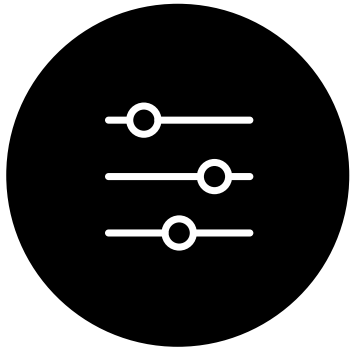
Summary of Features

Multi-beam, multi-orbit and multi-role with simultaneous SDA/SSA and SATCOM

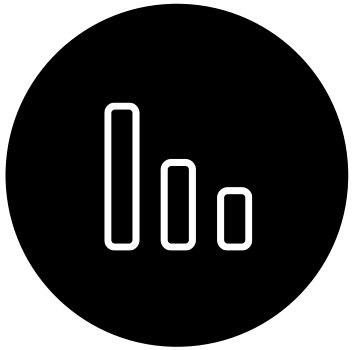
High-capacity service with no lost passes



Fully software defined, secure by design, open standards support



Customers can reconfigure missions on demand



Lower OPEX/TCO over time due to superior economics of scale

Phased Array Demonstrator (MVP)

CSIRO is responsible for delivering the phased array system up to the output of the beamformer, defined as the “Antenna Segment”, comprised of:

1. The Phased Array Receiver including the cryostat, array elements, LNA modules, warm electronics modules, power supplies, cryocoolers their associated drives and Helium compressors
2. Irukandji timing system,
3. The beamformer, and
4. The firmware and software required to interface to and operate the system.

Quasar is responsible for delivery of:

1. The communications and base band segment and control segment, and
2. System integration (in partnership with CSIRO).

MVP Development

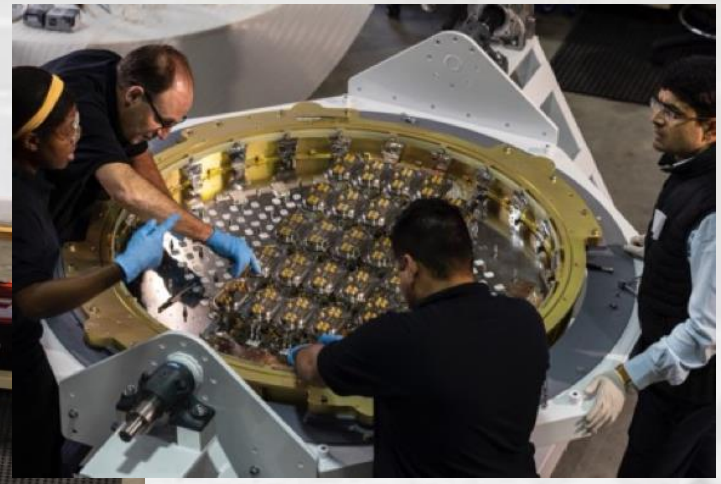
Project Constraints and Drivers

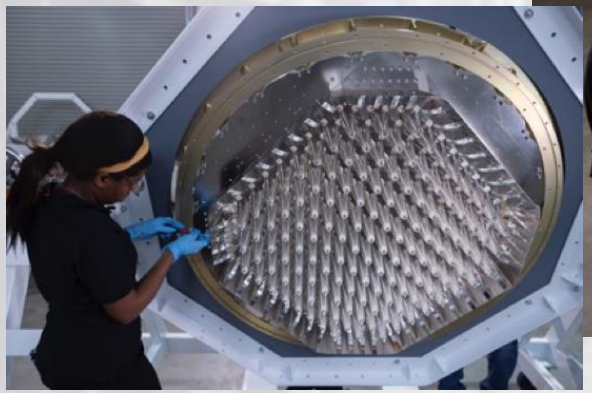
The timeline for MVP development was 24 months, "compressed" when compared to traditional radio astronomy developments.

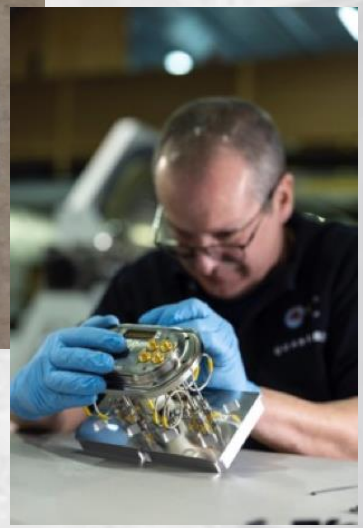
- Reuse of cryoPAF components wherever possible (e.g. digitiser, timing, power supplies, beamformer)
- Limited scope for design optimisation and new development (e.g. cryostat and array element design)
- Time to delivery prioritised – increased cost

MVP Development

Array Assembly



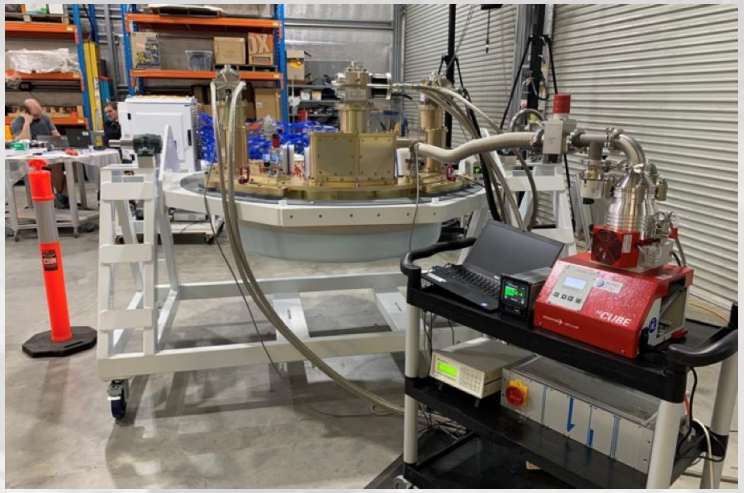


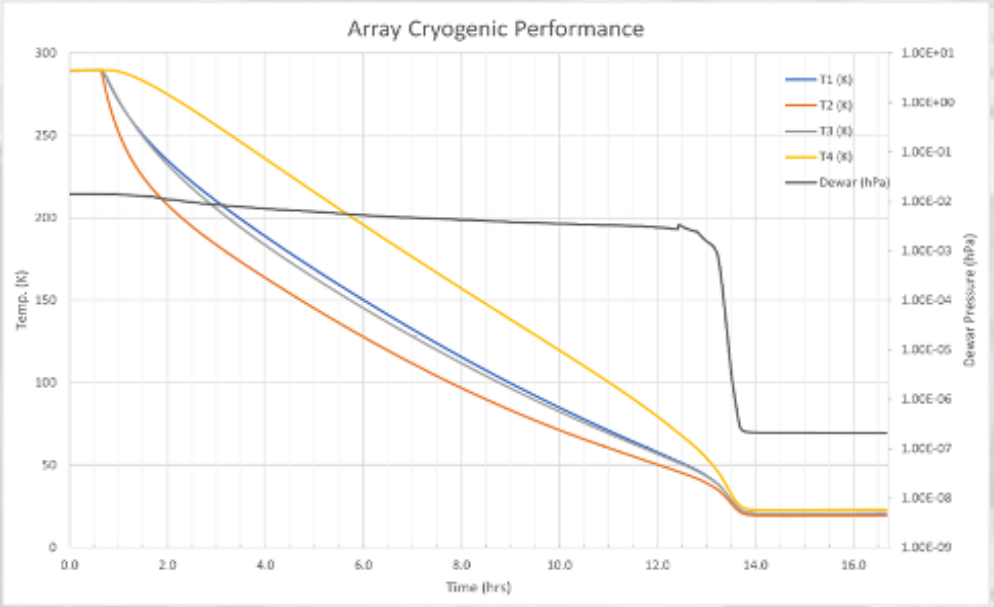


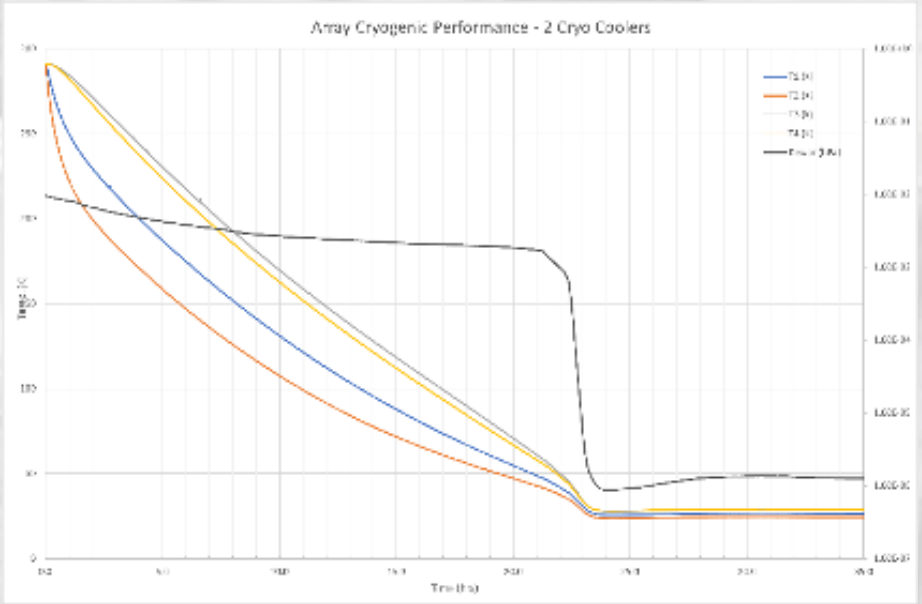
MVP Development

Array Cryogenic Testing

- Cryostat included all production hardware – except LNAs
- Tests conducted with combinations of 2 and 3 cryocoolers
- Operation meets specification with 2 cryocoolers



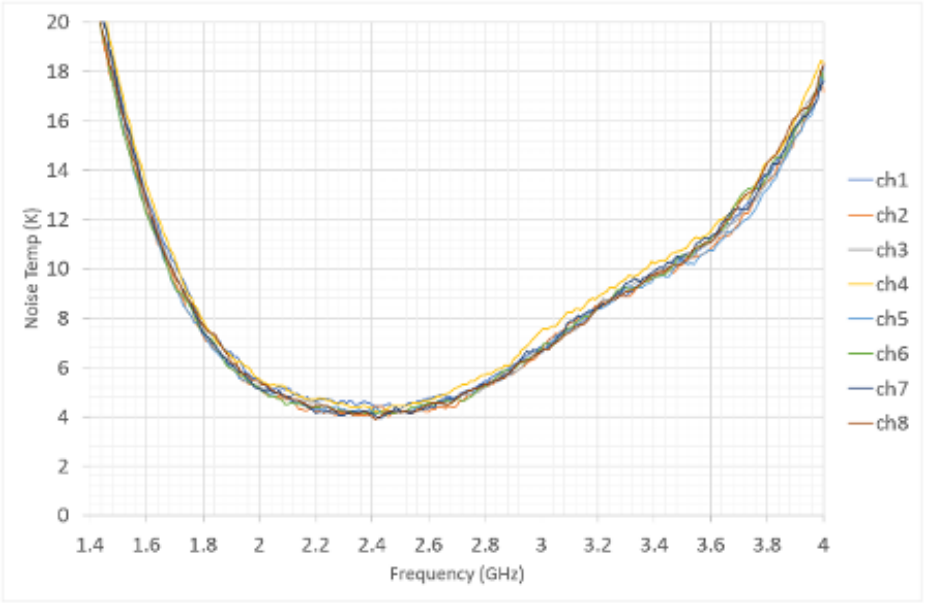


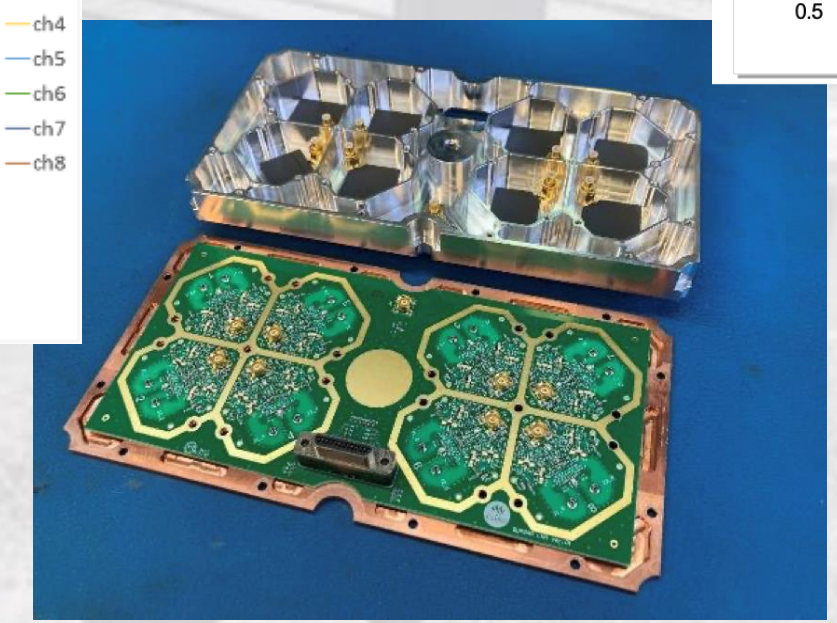


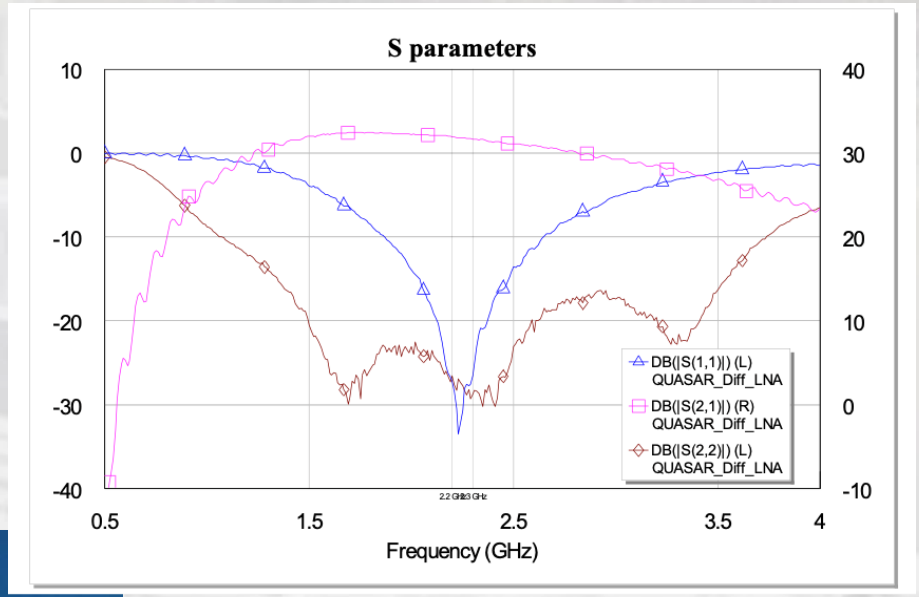
MVP Development

LNA Module

Yoon Chung







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MVP Deployment

- Deployment system enclosures – Quasar
- Demonstration site provided by industry partner – Vocus
- Site layout and design underway – CSIRO/Quasar partnership
- Site works start December 2022 – Vocus

Lessons – Currently being Learnt

Culture and ways of working for start-up are very different to CSIRO, this comes with benefits and challenges:

- Imperative is very different – research (rigorous and as good as it can be) verses start-up (agile and good enough to meet specification)
- CSIRO scale provides ability to weather issues (COVID) but slow and bureaucratic with multiple internal stakeholders
- Start-up needs to be agile, the company is growing and evolving as the project progresses
- The level of expertise within the start-up is changing as the project progresses

A good working relationship (understanding) between the teams and a desire to make it work on both sides is essential to success


STOP
EMPLOYEES
ONLY